of the radiations emitted by an incandescent body of which the emissive power is unity is expressed by the formula—

$$I = 10^{6 \cdot 7}\, T \frac{3210}{T}.$$

The temperatures employed range from 680° to 1770°, and these, with the observed intensity of radiation, have been used to plot a curve. By extending the curve and measuring the intensity of the radiation from the sun, an estimation of 7600° as the effective solar temperature is obtained. The term effective temperature is used to express that temperature which a body having an emissive power equal to unity should possess, in order to send out radiations of the same intensity as the sun. The real temperature of the photosphere is higher than 7600°, because its radiations are absorbed by the cooler solar atmosphere, and it may be, also, because the emissive power of the sun is less than unity.

COMET SWIFT, MARCH 6.—The following ephemeris for this comet is given in *Astronomische Nachrichten*, No. 3082, for 12h. Berlin mean time :—

1892.		R.A.		Decl.
		° ′ ″		° ′
April 8	...	21 16 41	...	+0 33·6
,, 9	...	21 20 18	...	1 34·2
,, 10	...	21 23 54	...	2 34·3
,, 11	...	21 27 28	...	3 33·8
,, 12	...	21 31 0	...	4 32·7
,, 13	...	21 34 30	...	5 30·9
,, 14	...	21 37 59	...	6 28·4
,, 15	...	21 41 25	...	7 25·2

WOLF'S COMET, 1891 II.—In *Astronomische Nachrichten*, No. 3082, an ephemeris for this comet is given by Herr Dr. Thraen, of which the following is an extract (12h. Berlin mean time) :—

1892.		R.A.		Decl.
		h. m. s.		° ′ ″
April 8	...	5 53 19·13	...	−0 12 43·2
,, 9	...	5 54 49·39	...	−0 7 21·8
,, 10	...	5 56 19·84	...	−0 2 7·1
,, 11	...	5 57 50·48	...	+0 3 0·9
,, 12	...	5 59 21·29	...	+0 8 2·1
,, 13	...	6 0 52·27	...	+0 12 56·6
,, 14	...	6 2 23·43	...	+0 17 44·3
,, 15	...	6 3 54·78	...	+0 22 25·1

PERIODIC PERTURBATIONS OF THE FOUR INNER PLANETS.—In the astronomical papers which are prepared for the use of the American Ephemeris and Nautical Almanac (vol. iii., part v.), most valuable computations of the periodic perturbations of the longitudes and radii vectores of the four inner planets of the first order as to masses are contributed. Prof. Newcomb, under whose directions these computations were made, tells us in the introductory note that in the preparation of the fundamental data for the new tables, all the coefficients, which are included in the expressions for the general perturbations, were redetermined : the values obtained for them agreed well with those obtained by Leverrier, and prove that their accuracy is placed beyond doubt.

To eliminate any errors that might have been made, duplicate computations were undertaken, and the results of them both are given in the final expressions for the perturbations in longitude. It may be stated that the complete theory is not here published, the secular variations, perturbations of the latitude, and those of long period in the longitude, not being printed, owing to their unfinished state.

N.P.D.'S OBSERVED WITH GREENWICH AND WASHINGTON TRANSIT CIRCLES.—Prof. Newcomb, under whose direction these computations were made, gives in vol. ii. part vi. of the same series of papers just referred to an interesting discussion on the differences that have been found in these observations. Those made with the Greenwich circle cover a period of thirty-six years, from 1851–87, while the Washington observations are included in the years 1866–86. The author has a firm basis here, on which he can rely, for in the former series the same methods of reduction and observation were in use for this entire period without interruption. He inquires first of all into the conclusions which can be gathered from the stability of the instrument, from both direct and reflection observations, and finds that the R–D corrections are mainly due to flexure. The constant of refraction and the possible periodic error due to those in the graduation of the circle are then dealt with, together with corrections for reductions to the equinox during the years 1851–56. The hypothesis of the secular change in the latitude is here considered as too improbable for acceptance with our present data, so that the apparent variations are here supposed to be due to the changes in the instrument or habits of the observers. In the section on the latitude of the Royal Observatory, he finds that the co-latitude derivable from observations of the four polar stars during the period 1877–86 is greater by 0″·31 than that derivable from observations of all circumpolar stars. At the conclusion of this investigation he gives a table showing the corrections to the north polar distances, derived annually from the observations with the Greenwich transit circle, to reduce them to the instrumental standard of the present paper, and the Pulkowa refractions.

WASHINGTON OBSERVATIONS, 1887.—All the observations which were made during the year 1887 at the United States Naval Observatory are included in this volume. The introduction, besides giving the report of the Superintendent on the state of the Observatory generally, contains all the detailed information relative to the methods of computing the observations made with the transit circle, meridian transit instrument, and the 26-inch and 9·6-inch equatorials. The principal work of the transit circle during this period has been upon the sun, moon, and planets, and miscellaneous stars. These last, included stars of the American Ephemeris for clock corrections, &c. ; stars whose occultations were observed at this Observatory, and by the various American parties that observed the 1874 transit of Venus ; those selected for standard stars in the formation of the catalogue made from 1846–49 ; and stars of the B.A.C. between 120° 0′ and 131° 10′ N.P.D. that have not been observed three times in R.A. and declination at Washington. The meridian transit instrument was devoted to the determination of the errors of the standard mean time clock in connection with the transmission of time, and 1645 transits were taken. The clock's rate was found satisfactory, its variations following closely those of the barometer. The 26-inch and 9·6-inch equatorials have been also used, the former for observations of double stars and small stars in the Pleiades, the latter for comets. Besides these, many other magnetic and meteorological observations are recorded, but a brief account of them will be found in the notes.

FERTILIZATION OF THE CASUARINACEÆ.

FEW recent articles in botanical literature can compare in interest and importance with that contributed by Dr. Melchior Treub to the tenth volume of the *Annales du Jardin Botanique de Buitenzorg*, "On the *Casuarinaceæ*, and their Position in the Natural System." The startling announcement is made of the occurrence of a mode of fertilization of the ovule essentially different from that which takes place in other flowering plants.

The species of the genus *Casuarina*, which alone make up the order, are about twenty-three in number, and are trees, nearly all natives of Australia, where they are known as "beef-wood trees," characterized by their jointed, almost leafless branches. From the catkin-like inflorescence of very imperfect flowers, they are generally placed among Incompletæ or Monochlamydeæ, near to Myricaceæ and Juglandaceæ. The female flower is composed of two carpels, without either calyx or corolla, and has at the base an ovarian cavity, in which are formed (in *C. suberosa*) the two ovules with parietal placentation, but connected from the first with its summit by cords of cellulose. Corresponding to the style in most plants, is an axial mass of tissue which M. Treub calls the stylar cylinder, surrounded by a peripheral region containing tracheides, and terminating in two elongated stigmas. The two ovules are unequal in size, and coalesce in their growth by their placental portions ; the connection between them and the base of the stylar column is called the bridge ; they are also connected with the base of the ovarian cavity by their funicles.

The processes which take place within the ovule up to the time of the formation of the embryo-sac are very different from those hitherto observed in Angiosperms. Several large hypodermal cells, the archespore-cells, at the summit of the nucellus, divide tangentially ; and two of the cells thus produced towards the inner side, the primordial mother-cells, divide further, giving rise to a thick cylinder of large cells occupying the centre of the nucellus, the sporogenous tissue, surrounded by flattened cells corresponding to the "Tapetenzellen" of Goebel. The cells of the sporogenous tissue are equivalent to the mother-cells of the embryo-sac in other Angiosperms. These cells divide transversely into large megaspores (macrospores) ; the small inactive

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cells become absorbed. In *C. glauca* and *Rumphiana* tracheides are formed, analogous to the elaters of the Hepaticæ; their function is uncertain. The megaspores, or embryo-sacs, of which there are usually from sixteen to twenty, lengthen in the direction of the chalaza, some of them sometimes penetrating and forming "tails" between the elements of the fibrovascular bundle of the funicle. The sister-cells of the embryo-sacs, instead of being absorbed at an early period, as in other Angiosperms, disappear only much later. The megaspores which develop fully divide at the end into two or three cells, which are in most cases naked, and result from the division of a single cell. In the great majority of cases only a single megaspore in each nucellus has these terminal or sexual cells furnished with cell-walls; this is the future embryo-sac. The oosphere is always formed from the sexual cell which has the thickest wall. No antipodals are formed.

Only a single ovule is ever fertilized, and the pollen-grain which fecundates it advances towards the embryo-sac in a way entirely different from anything that occurs in other Phanerogams. The pollen-tube does not enter the ovarian cavity; it descends the stylary cylinder, crosses the bridge and the tissue which unites the ovule with the wall of the ovary, and arrives at the fibrovascular bundle which leads to the chalaza, where it produces two short branches, then traverses the chalaza, and enters the ovule by means of the "tail" of a sterile megaspore, and continues its course towards the embryo-sac. Towards the middle of the nucellus it contracts, tapers off, and ruptures, the terminal fecundating portion becoming separated from the rest of the pollen-tube. This portion, which has a thickened wall, and contains distinct protoplasm, never enters the micropyle or the embryo-sac, but becomes firmly attached to the wall of the latter, at a spot variable in position, but always at some distance from the sexual apparatus. Dr. Treub has not, at present, been able to detect in this portion a definite nucleus, or to follow the actual process of fecundation. During the development of the embryo-sac, numerous endosperm-nuclei are formed, and subsequently the embryo makes its appearance. The mode of development of the embryo does not differ from that which occurs in other Dicotyledons.

The peculiar processes which accompany the act of fecundation, and the presence of a large number of megaspores, each containing a sexual apparatus, induce Dr. Treub to regard the Casuarinaceæ as a distinct group of Angiosperms, of equal rank with the Monocotyledones and Dicotyledones together, and he proposes the following primary classification of Phanerogams:—

I. Gymnosperms.
II. Angiosperms.
  A. Chalazogams (Casuarinaceæ).
  B. Porogams.
    1. *Monocotyledones.*
    2. *Dicotyledones.*

The Chalazogams are not intermediate between Gymnosperms and Angiosperms, but occupy an isolated and inferior position among the latter, somewhat analogous to that of *Lycopodium* among Vascular Cryptogams. The paper is illustrated by 21 fine plates. A. W. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—*Endowment of Original Research.*—The following notice has been received by the Vice-Chancellor:—A gentleman has established a Scholarship of £100, tenable for one year, for the encouragement of original research. The Scholar will be selected by a Committee composed of Dr. George Thin, Surgeon-General Cornish, and Prof. A. Winter-Blyth. The conditions of the Scholarship are, that the research be on a subject requiring for its elucidation both chemical and bacteriological methods, and the subject will be selected by the Committee of Selection. With the concurrence of the Scholar, the work is to be done in the laboratories of the College of State Medicine, 101 Great Russell Street, W.C., and the Scholar will have to devote his whole time to the work. Application to be made to Surgeon-General Cornish, on or before April 18, 1892.

In a Convocation held on April 5, it was decreed (the Council of the Royal Geographical Society having offered a further sum of £150 a year, to be met by an equal sum from the University, for the payment of a Reader in Geography during the next five years) that the offer be accepted, and that the thanks of the University should be conveyed to the Council of the Royal Geographical Society for their liberal offer.

The programme of the fifth summer meeting of University Extension and other students, to be held in Oxford in July and August 1892, has been issued, and in its general character resembles that of last year. The inaugural lecture will be delivered by Mr. John Addington Symonds (if his health permits) on Friday, July 29, at 8.30 p.m. The meeting will, as in former years, be divided into two parts, viz. from July 29 to August 9, and from August 10 to August 26. In Natural Science the following arrangements have been made:—

In Chemistry: a course of eighteen days' practical instruction in the University laboratory, limited to 100 students, conducted by Messrs. J. E. Marsh and A. D. Hall of Balliol College.

In Geology: a special course of fourteen days' practical instruction, with field work provided, if at least 40 students offer themselves.

In Botany: in addition to lectures on primroses and their relations, it is proposed to arrange, for a class of not less than 40 students, a three weeks' course of practical instruction.

In Biology: to the same minimum number of students is offered a special course of lectures and demonstrations in the physiological laboratory, to form an introduction to the study of life, and especially of nervous organisms.

Courses of lectures and instruction on Astronomy, Mechanics, Sound, Light and Heat, Electricity, Physiography, and Hygiene can be arranged.

It is also announced that there will be no summer meeting in 1893, as during August in that year the Examination Schools will be in the hands of workpeople.

St. Andrews.—*Summer Session.*—A course of lectures in zoology and botany, qualifying for graduation, will commence on May 2, the former by Prof. Prince, the latter by Mr. Robertson, the University Lecturer on Botany. These are open to students of either sex.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 31.—"Aberration Problems: a Discussion concerning the Connection between Ether and Matter, and the Motion of the Ether near the Earth." By Oliver Lodge, F.R.S., Professor of Physics, University College, Liverpool.

The paper begins by recognizing the distinction between ether in free space and ether as modified by transparent matter, and points out that the modified ether, or at least the modification, necessarily travels with the matter. The well-known hypothesis of Fresnel is discussed and re-stated in modern form.

Of its two parts, one has been verified by the experiment of Fizeau, the other has not yet been verified. Its two parts are, (1) that inside transparent matter the velocity of light is affected by the motion of that matter, and (2) that immediately outside moving matter there is no such effect. The author proceeds to examine into the truth of this second part, (1) by discussing what is already known, (2) by fresh experiment.

The phenomena resulting from motion are four, viz.:—

(1) Changes in direction, observed by telescope and called aberration.

(2) Change in frequency, observed by spectroscope and called Doppler effect.

(3) Change in time of journey, observed by lag of phase or shift of interference bands.

(4) Change in intensity, observed by energy received by thermopile.

After a discussion of the effects of motion in general, which differ according as projectiles or waves are contemplated, the case of a fixed source in a moving medium is considered; then of a moving source in a fixed medium; then the case of medium alone moving past source and receiver; and, finally, of the receiver only moving.

It is found that the medium alone moving causes no change in direction, no change in frequency, no detectable lag of phase, and probably no change of intensity; and hence arises the difficulty of ascertaining whether the general body of the ether is moving relatively to the earth or not.

A clear distinction has to be drawn, however, between the effect of general motion of the medium as a whole, and motion

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